Jl S. Afr. Bot. 45 (1): 11–23 (1979)

THE MORPHOLOGY OF *ACACIA REDACTA* J. H. ROSS

P. J. Robbertse and Irmgard von Teichman
(Department of Botany, University of Pretoria)

Abstract

Acacia redacta J. H. Ross is a small, much-branched shrub which grows in the Richtersveld. Ross (1974) provisionally placed it in the genus *Acacia* as fresh flowers and seeds were not available to aid him in his decision.

In this investigation the pollen, seeds, seedling and the anatomy of the pod, seed, wood and pinnules were studied. According to these characters *A. redacta* does not fit in with either of the two subgenera of *Acacia* represented in South Africa, or with *A. albida* (= *Faidherbia albida* (Del.) A. Chev.). If this new information could be supported by a chromosome study it might become necessary to regard *A. redacta* J. H. Ross as a new monotypic genus.

Uittreksel

DIE MORFOLOGIE VAN *ACACIA REDACTA* J. H. ROSS

Acacia redacta J. H. Ross is 'n klein veel-vertakte struik wat in die Richtersveld groei. Ross (1974) het dit voorlopig in die genus *Acacia* geplaas omdat daar geen vars blomme of saad beskikbaar was om hom in sy besluit te help nie.

In hierdie ondersoek is die stuifmeel, saad, saailinge en die anatomie van die peul, saad, hout en blaartjie bestudeer. Hiervolgens pas die kenmerke van *A. redacta* nie in by of die twee subgenera in Suid-Afrika of *A. albida* (= *Faidherbia albida* (Del.) A. Chev.) nie. Sou hierdie nuwe gegewens bevestig word deur 'n chromosoomondersoek mag dit nodig blyk om *A. redacta* J. H. Ross as 'n nuwe monotipiese genus te beskou.

Introduction

Acacia redacta was described by Ross in *Bothalia* (Ross, 1974) using material collected by Leistner & Werger in the Richtersveld. No ripe seed or fresh flowers were collected and, because Ross could not examine this plant fully, he "provisionally" placed it in the genus *Acacia*.

On a collecting trip to the Richtersveld in September 1977, ripe seeds, pods, dead flowers, young twigs with developing inflorescences, wood and herbarium specimens of plants growing on the western slope of a mountain of the eastern side of Jenkinskop, 20 km north of Eksteenfontein (Stinkfontein) -2817 (Vioolsdrif): CB (*Robbertse 1168*) were collected. This material was studied in order to evaluate the taxonomic position of this very interesting plant.

Material and Methods

The material mentioned above was fixed and preserved in FAA. For the anatomical investigation, the FAA-preserved material was dehydrated in ethylene

---

Accepted for publication 5th May, 1978.

glycol monomethyl ether, ethanol, propanol and butanol, infiltrated with GMA and embedded according to Feder and O'Brien (1968). Our monomer mixture, however, consisted of 95 % (v/v) hydroxyethyl methacrylate (purified in our laboratory to eliminate the methacrylic acid), 5 % (v/v) polyethylene glycol 200 and 0,1 % (w/v) azobis-iso-butyronitrile. Sections, 2 μm thick were cut with glass knives on a MT-1 "Porter Blum" ultramicrotome. The sections were stained with periodic acid—Schiff's reagent (PAS), followed by toluidine blue in benzoate buffer, pH 4,4 (Feder and O'Brien, 1968). The blocking agent, DNPH however, was applied for 30 minutes.

RESULTS AND DISCUSSION

Description

Small, much-branched shrubs, 0,3–1 m high (Fig. 1A). Bark dark grey-brown, firm, peeling in small strips. Young branches grey-brown, densely pubescent, with numerous, purplish-brown glandular bodies, consisting of tanniniferous cells on short stalks. Stipules spinescent, slender, straight, those of well-developed euphylls about 155 mm long, pubescent. *Leaves* bipinnate with two pinnae (Fig. 1B); petiole slender without adaxial gland, 2–6 mm long; rachilla 5–10 mm long; mucro prominent, up to 4 mm long; pinnules 2–4 pairs but mostly 3 pairs per pinna, 2–5 × 1,5–3 mm, oblique, oblong or elliptic, apex rounded or obtuse (Figs 1 and 4), densely appressed pubescent on both surfaces, with scattered reddish-brown glandular bodies. *Inflorescence* pseudocapitate, axillary; peduncles 4–10 mm long with sterile bract on upper half, appressed pubescent with scattered glandular bodies. *Flowers* mostly three per inflorescence (Fig. 4B), sessile in axil of claw-shaped bract. Calyx cupular, 1–1,5 mm long, pubescent. Corolla 4-6 mm long, pubescent. *Stamens*: filaments 12–15 mm long, shortly connate basally to form a short tube, anther without gland. *Pollen* in polyads of 7–10, mostly 8 cells (Figs 1B, 2C and D); polyads irregular ellipsoidal, 130 × 110 μm; peripheral monads 5–6, smooth, without furrows, 50 μm along the polar axis and 63 μm wide, with four distal pores; exine 1,8 μm thick, central monads (4), 2, 1 or absent, smaller than peripheral monads. *Ovary* shortly stipitate to almost sessile. *Pods* erect, cream with purple edges 26–40 mm long, linear, oblong, straight, acute apically, 1–2, seeded, puberulous with scattered glandular bodies, dehiscent, splitting from apex to base in two recurving valves. *Seed* compressed grey-brown with maroon speckles, flattened and pointed at hilar end, 7–9 mm long, 5–6 mm wide, rapheole horseshoe-shaped (Fig. 5), central 1,5–2,5 mm long and 2 mm wide, funicle swollen at the placental end, tapering towards the hilum.

Seedling (Fig. 1B)

The seedling belongs to group 8B (Robberste & van der Schijff, 1971). Germination is epigeal and a well-developed taproot (Fig. 1B–R) is formed without a collar at the transition of the root to hypocotyl (see Vassal, 1969). The hypocotyl is 27–33 mm long, and the cotyledons 12,6 × 12 mm with petioles 1–1,7 mm long. One or two prominent stipular spines per cotyledon occur. The first internode is less than 1 mm long, and the first vegetative leaf pinnate with three pinna pairs and prominent stipules. The pinnae are oblique, elliptic or subrotund, 5 mm long and 3,5 mm wide, and the apex mostly apiculate or rounded. One basal pinna is often rudimentary. The second and all subsequent leaves are bipinnate with two pinnae, each with three to four pinna pairs. Leaves and stem are puberulous with reddish-brown glandular bodies concentrated at the bases of leaves, pinnae and pinnules.

Anatomy of the stem

The epidermal cells are tanniniferous with thick, lignified outer tangential walls. The trichomes are unicellular, fibre-like cells, 100–130 μm long. The first cortical layer consists of enlarged, tanniniferous cells, followed by 7–9 layers of thin-walled parenchymatous cells containing a pinkish cell sap. A continuous sclerenchymatous cylinder of 1–4 cell layers of primary phloem fibres is found in the young stems. In older stems the cylinder is discontinuous due to secondary growth. A periderm originates from the subepidermal layer and the cortical cells continue dividing to keep pace with secondary growth. Strands of secondary phloem fibres are formed in the secondary phloem.

Wood anatomy

The wood is diffuse porous with pores in clusters in tangential groups. The tangential diameter of the pores is (24-) 38 (-75) μm. Axial xylem parenchyma is vasicentric paratracheal. Vessel elements are (60-) 81 (-90) μm long with gum deposits in vessels of the central wood. Intervascular pits are 5,6–7,5 μm in diameter, alternate and vestured. Perforations are simple. Septate and gelatinous fibres are present. The rays are uni- to triseriate but mostly uniseriate.

Anatomy of the pod

In a cross section of the seedless parts, the pod is dumb-bell-shaped with the dorsal and ventral veins situated in the thickened ends. The inner epidermis and the first one or two subepidermal cell layers are tanniniferous while the unicellular trichomes lack tannin. These cell layers are followed by two layers of relatively large parenchymatous cells which, after fixation in FAA contain a reticulate cytoplasm. This is followed by 6–8 layers of smaller parenchymatous cells, two to three layers of longitudinal fibres, one or two layers of transverse fibres and a thin-walled inner epidermis. The vascular bundles of the dorsal and ventral veins are capped with sclerenchymatous fibres.

Anatomy of the testa (Fig. 6A)

The description is based on a cross section through the middle (equator) of the seed.

The seed coat is 225–240 μm thick; the macrosclereids 31,9–33,5 μm long. The light line in the greater part of the testa is situated 7,5 μm from the cuticle but on both sides of the pleurogram it is 18,75 μm from the cuticle. Osteosclereids are flask-shaped, (38-) 45 (-56) μm long with a narrow neck. The mesotesta is 23–26 μm thick and consists of 5–7 layers of thick-walled, elongated cells with intercellular spaces and an inner layer with scattered, poorly-developed osteosclereids.

A uniserial endotesta of thin-walled elongated cells is appressed to a membrane consisting of the collapsed inner integument cells.

Anatomy of the leaf

As in all other South African *Acacia* spp., the nodes are trilacunar (Robbertse, 1975a). The three leaf traces unite in the leaf base to form a closed vascular cylinder which breaks up into a larger abaxial, a smaller adaxial and two lateral adaxial bundles.

The pinnule is amphistomatic (Fig. 6B) and the epidermis is tanniniferous with unicellar trichomes. The abaxial and adaxial palisade layers are separated by relatively large, colourless cells (Fig. 6B). This is a typical character of pinnules of the subgenus *Aculeiferum* (Vulgares, Robbertse, 1975a).

DISCUSSION

Concerning the taxonomy of *A. albida*, the following is noted briefly. Ross (1975) states that "*A. albida* displays a number of unusual characters, some of which are peculiar to this species alone amongst the African acacias". "Chevalier in Rev. Bot. appl. Agric. trop. **14:** 876 (1934) considered the species to be sufficiently distinct from all others to transfer it to the monotypic genus *Faidherbia*." Ross (1975), however, concludes that "in deciding whether or not the species should be excluded from *Acacia*, it depends upon whether the emphasis is placed on the differences or on the similarities. It may ultimately prove better to transfer the species to *Faidherbia*."

The habit of *A. redacta* is different from all other South African *Acacia* spp. and is more or less similar to *Xerocladia viridiramis* (Burch.) Taub., also a mimosoid plant from the arid south western parts of the country (Ross, 1975). The plants grow on dry, rocky west-facing mountain slopes where they blend with other small shrubs of the succulent Karoo.

Acacia redacta differs from other South African *Acacia* spp. in having inflorescences containing mostly only three flowers (Fig. 4B). Ross (1975) described the inflorescence as "apparently capitate". As can be seen in Fig. 4B the fertile part of the inflorescence axis is reduced while a sterile bract appears on the upper half of the scape. This sterile bract can be regarded as a reduced cupule (involucel), which is a typical character of the subgenus *Acacia* (Gummiferae sensu Bentham) (Robbertse, 1974).

At the time when the material for this study was collected the dried flowers were still on the plants while young inflorescences in different ontogenetic stages were found in the axils of distal* leaves (Figs 3 and 4A). The young distal leaves and inflorescences develop simultaneously (Figs 3A & B) during the growing season which, in this winter rainfall area, can be from May to September. The best-developed flowers found already had well-differentiated microspore mother cells in the anthers (Fig. 2A). This early development of the flowers enables the plants to burst into flower immediately after the first autumn rains (± May).

No other South African *Acacia* spp. except *A. albida*, flowers in autumn (± May) to winter (Robbertse, 1974). The seeds of *A. albida* ripen towards the end of September and ripe seeds were also found on *A. redacta* during this collecting trip (see Introduction).

In Table 1 an evaluation of the outstanding characters of *A. redacta* is given in relation to typical characters of *A. albida*, and the subgenera *Acacia* and *Aculeiferum*. From the table it is clear that *A. redacta* can neither be regarded as a member of the subgenus *Acacia* nor the subgenus *Aculeiferum* since characters of both taxa are found in this species. It has more characters in common with *A. albida* but on the basis of the morphology of its inflorescence, pollen and seed, it is unique.

The polyads of *A. redacta* with 8 monads are 130 μm × 110 μm in diameter while according to van Zinderen Bakker and Coetzee (1959) the polyads of *A. albida* with 16–30 monads is 98,4 μm and that of *A. giraffae* (= *A. erioloba*) 75 μm. According to Guinet (1969) the polyads of all other *Acacia* spp. vary between 30 μm × 20 μm to 61 μm × 61 μm which is about the size of a single monad of *A. redacta*. The combination of the characters of a capitate inflorescence and flowers with connate stamens which is found in *A. redacta* is also unknown in the genus *Acacia*. The taxon *A. redacta* J. H. Ross is therefore probably not an *Acacia* spp. and should rather be regarded as a new, monotypic genus. A chromosome study will probably supply the crucial evidence for such a decision.

ACKNOWLEDGEMENTS

This research was sponsored by the South African Council for Scientific and Industrial Research and by the University of Pretoria. The technical help of Miss J. Hoogenhout is acknowledged, while Mrs J. E. Lombard is thanked for reading the manuscript.

---

*See Robbertse 1975a.

TABLE 1.
Evaluation of characters of *Acacia redacta*.

Characters for *A. redacta*	Character typical for		
	A. albida	Subgenus Acacia	Subgenus Aculeiferum
1. Stipular spines (Robbertse, 1975b) .	×	×	
2. Inflorescence capitate with involucel (Robbertse, 1974)		×	
3. Stamens connate at base (Robbertse, 1974)	×	–	–
4. Gland on anther absent (Robbertse, 1974)	×	–	–
5. Pollen grains without furrows (van Zinderen Bakker & Coetzee, 1959)	×		×
6. Ovary almost sessile (Robbertse, 1974)		×	
7. Glandular disc in flower absent (Robbertse, 1974)		×	
8. Transverse and longitudinal fibres in pod (Robbertse, 1975c)	×		×
9. Rays in wood uni- to triseriate (Robbertse, unpubl.)	×		×
10. Palisade in pinnule interrupted by spongy mesophyll (Robbertse, 1975a)	×		×
11. Collar at junction of root and hypocotyl absent			× some spp.
12. Position of light line in testa (Robbertse, 1973)		×	

REFERENCES

FEDER, N. and T. P. O'BRIEN, 1968. Plant Microtechnique: Some Principles and New Methods. *Am. J. Bot.* **55**(1): 123–142.

GUINET, Ph., 1969. *Les Mimosacees*. Étude de palynologie fondametale, corrélations, evolution. Institut Francais de Pondichéry Travaux de la Section Scientifique et Technique. Tome **9:** 1–293.

ROBBERTSE, P. J. and H. P. VAN DER SCHIJFF, 1971. The genus *Acacia* Miller in South Africa V. *Mitt. bot. StSamml., Münch.* **10:** 170–177.

ROBBERTSE, P. J., 1973. Die genus *Acacia* in Suid-Afrika III (Met spesiale verwysing na die morfologie van die saad). *Tydskr. Natuurwet.* **13**(2): 72–95.

————, 1974. The genus *Acacia* in South Africa II (With special reference to the morphology of the flower and inflorescence). *Phytomorphology* **24**(1 & 2): 1–15.

————, 1975a. The genus *Acacia* in South Africa VI (The morphology of the leaf). *Boissiera* **24:** 263–270.

————, 1975b. The genus *Acacia* in South Africa I (With special reference to the morphology of the stipules and spines). *Bothalia* **11**(4): 473–479.

————, 1975c. The genus *Acacia* in South Africa IV (With special reference to the morphology of the pod). *Bothalia* **11**(4): 481–489.

ROSS, J. H., 1974. Notes on *Acacia* species in Southern Africa: IV. *Bothalia* **11**(3): 231–234.

————, 1975. Fabaceae. In: *Flora S.Afr.* **16**(1): 44–46; 104–105.

VAN ZINDEREN BAKKER, E. M. and J. A. COETZEE, 1959. *South African Pollen Grains and Spores* Part III. Cape Town: Balkema.

VASSAL, J., 1969. Contribution a L'etude de la Morphologie des Plantules D'*Acacia* Acacias Africains. *Bull. Soc. Hist. nat. Toulouse* **105:** 55–111.

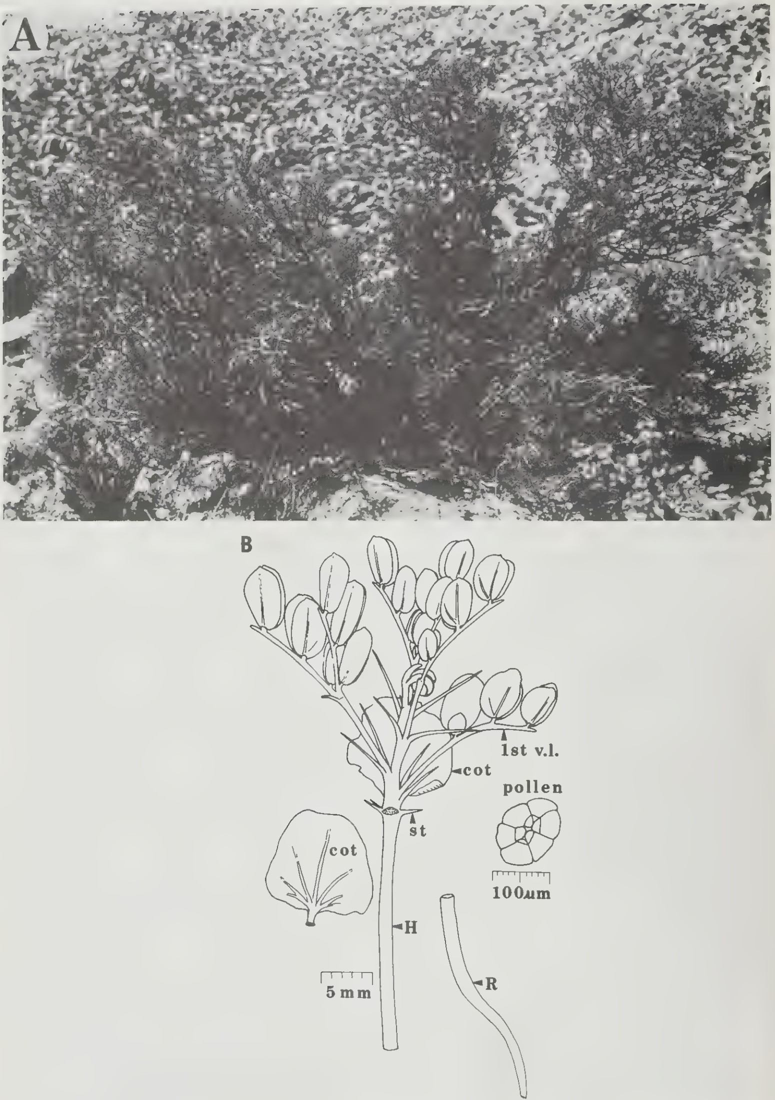

Fig. 1.
The habit of *A. redacta* (A) and the seedling (B) also showing a pollen polyad. *cot*—cotyledon; *H*—hypocotyl; *R*—root; *st*—stipule; *1st v.l.*—first vegetative leaf.

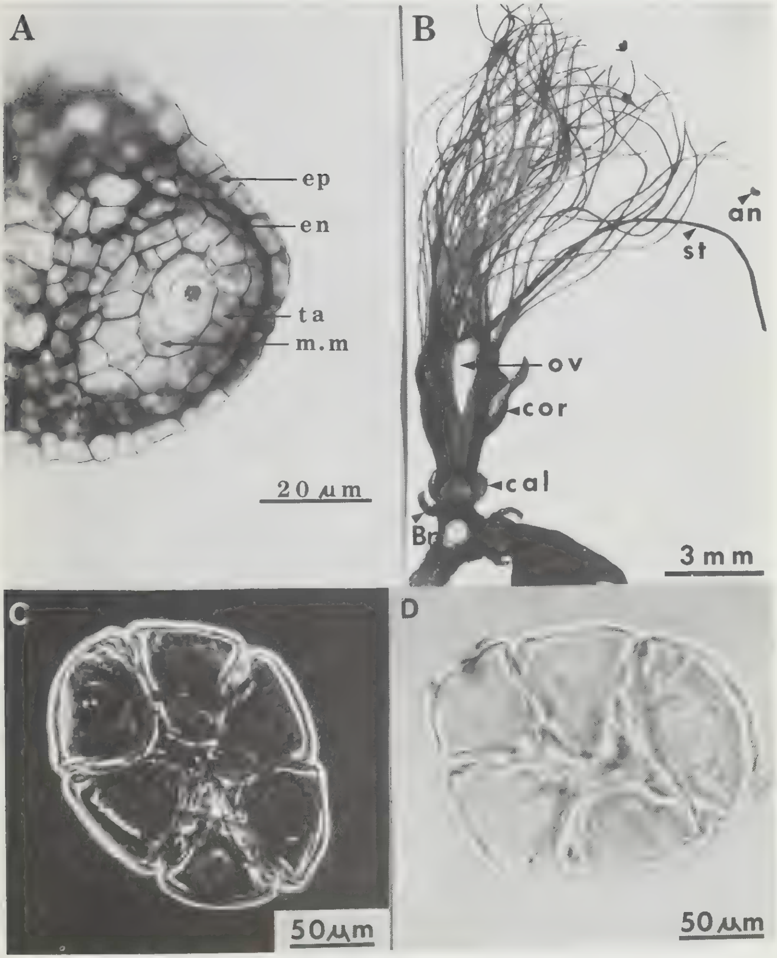

FIG. 2.
A cross section of an anther (A); B—a flower; C and D—pollen polyads. *an*—anther; *Br*—bract; *cal*—calyx; *cor*—corolla; *en*—endothecium; *ep*—epidermis; *m.m*—microspore mother cell; *ov*—ovary; *st*—style; *ta*—tapetum.

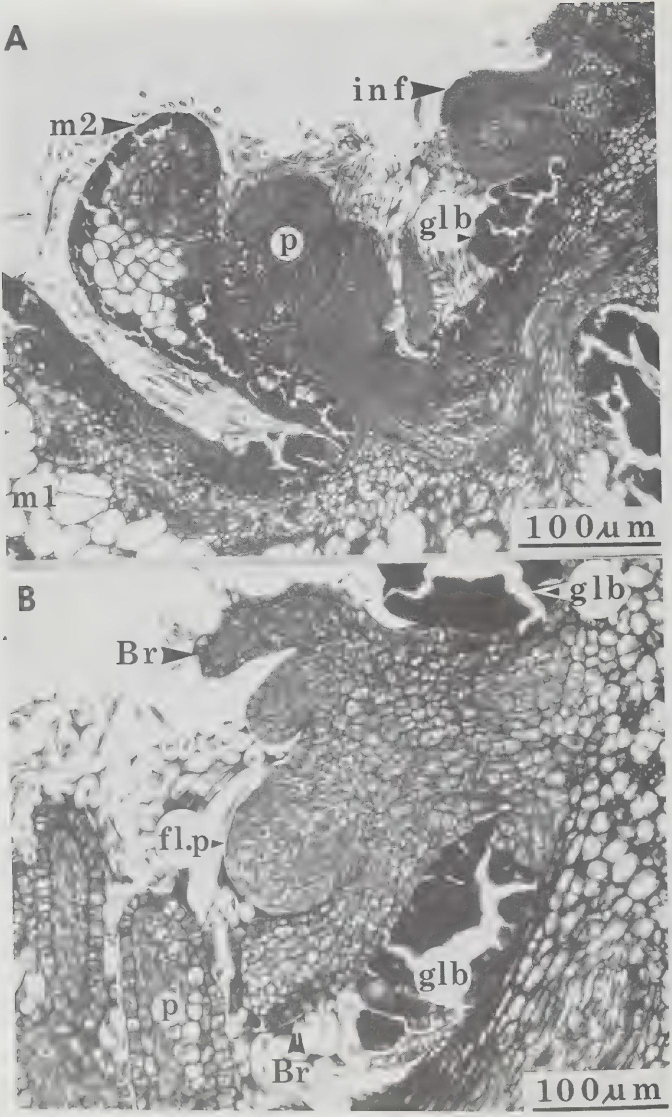

FIG. 3A and B.

Longitudinal sections of developing leaf and inflorescence. *Br*—bract; *fl.p*—floral primordium; *glb*—glandular bodies; *inf*—inflorescence; *m1*—mucro of rachis; *m2*—mucro of pinna; *p*—pinnule.

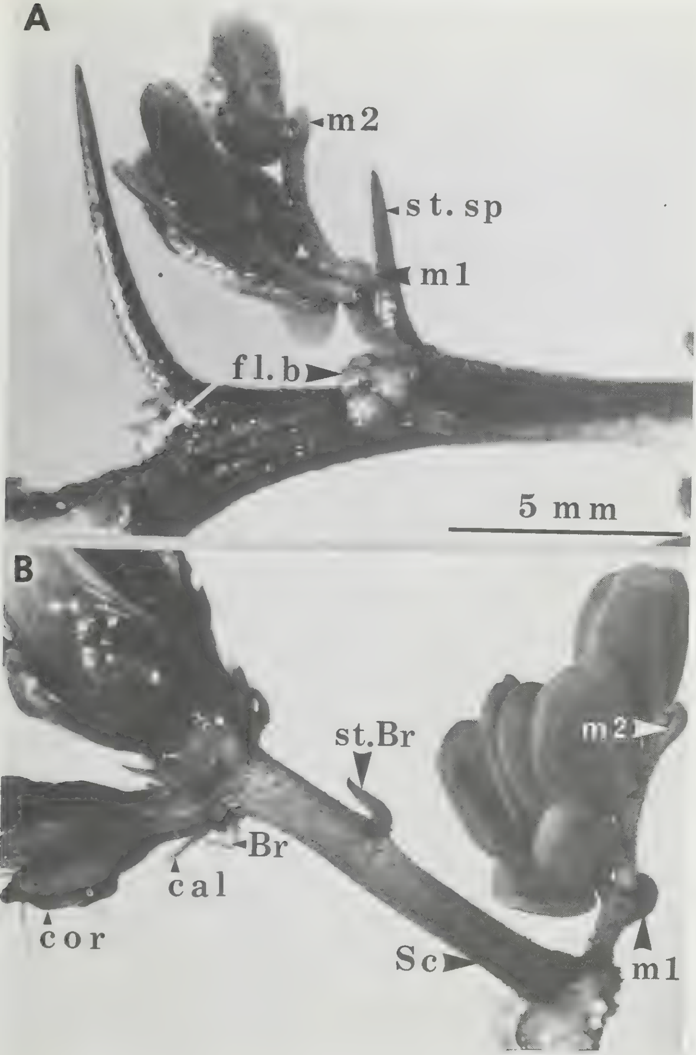

FIG. 4.
A twig with flower buds (A) and an inflorescence with subtending leaf (B). *Br*—bract; *cal*—calyx; *cor*—corolla; *fl.b*—flower buds; *m1*—mucro of rachis; *m2*—mucro of pinna; *Sc*—scape; *st.Br*—sterile bract; *st.sp*—stipular spine.

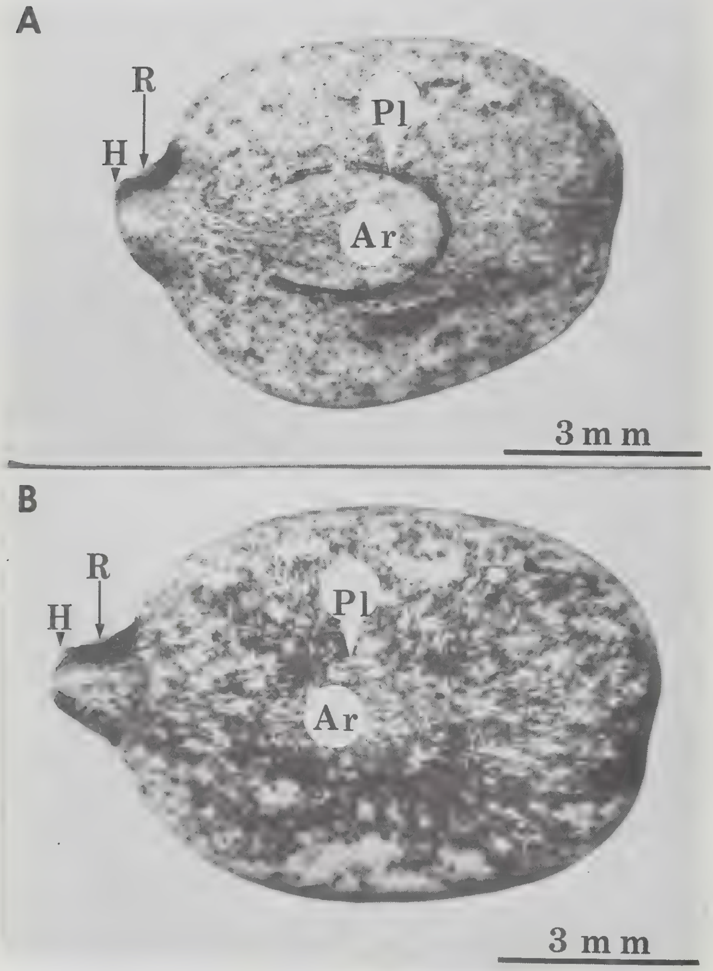

FIG. 5A and B.
Different seeds of *A. redacta*. *Ar*—areole; *H*—hilum; *Pl*—pleurogram; *R*—rapheole.

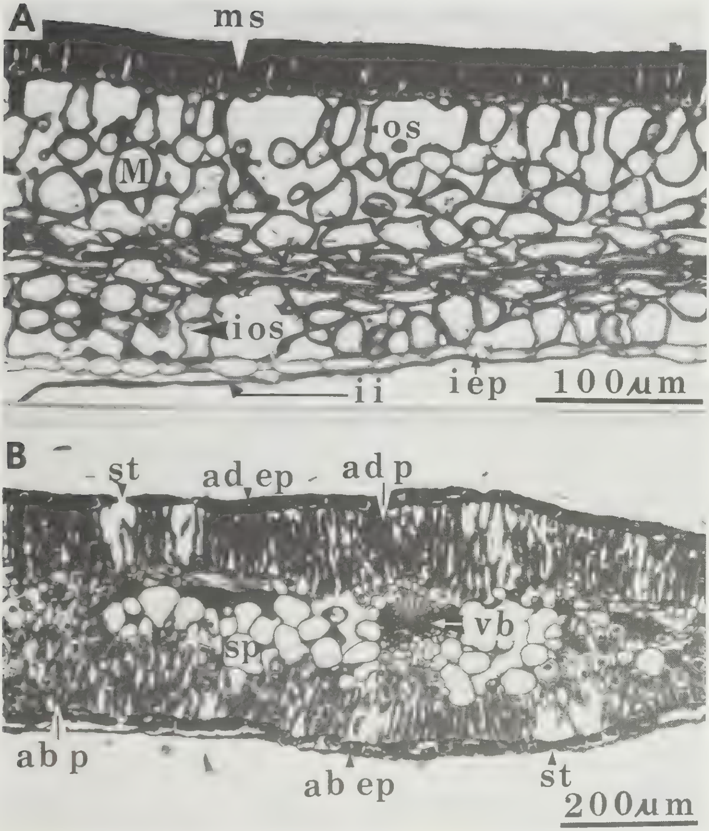

FIG. 6.

Cross sections of the testa (A) and a pinnule (B). *ab ep*—abaxial epidermis; *ab p*—abaxial palisade; *ad ep*—adaxial epidermis; *ad p*—adaxial palisade; *iep*—outer integument epidermis; *ii*—inner integument; *ios*—inner osteosclereids; *M*—mesophyll; *ms*—macrosclereids; *os*—osteosclereids; *sp*—spongy mesophyll; *st*—stomata; *vb*—vascular bundle.